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TEXAS AGRICULTURAL EXPERIMENT STATION

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

W. B. BIZZELL, President

BULLETIN NO. 250 OCTOBER, 1919

EXPERIMENT STATION AND EXTENSION SERVICE
COOPERATING

STORAGE AND DISEASES OF THE SWEET POTATO IN TEXAS

IMPERIAL BUREAU
13 JUL 1921
OF MYCOLOGY

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FOREWORD.

Sweet potato storage is a comparatively new industry in Texas. During the past few years, however, a great deal of interest has been manifested in improved methods of storage and this industry is now developing rapidly.

Before storage houses came into use, the sweet potato crop was unprofitable, except on a small scale. The old style "banking" of potatoes proved unsatisfactory and was practical only in a small way. Because of improper storage facilities, potatoes had to be marketed in the fall at harvesting time, a practice which resulted in the glutting of the markets, and consequently in low prices. But with efficient storage houses the period during which sweet potatoes can be marketed will be greatly extended. The prices paid for them will be stabilized. As the number of storage houses increases, the sweet potato will become one of the big staple crops of Texas.

Extensive studies have been made in sweet potato storage by a committee composed of the following members of the Texas Agricultural Experiment Station and Extension Service staffs:

J. J. Taubenhaus, Plant Pathologist, Experiment Station.
E. A. Miller, Sweet Potato Storage Specialist, Extension Service.
H. M. Eliot, Farm and Ranch Economist, Experiment Station.
B. F. Brown, Rural Economist, Extension Service.
A. K. Short, Agronomist, Extension Service.

As a result of their studies and from data collected on this important subject, the Texas A. and M. storage house, which is described in this bulletin, was developed. This type of house has been given a severe test under adverse conditions, and has proved very satisfactory. It is relatively low in cost of construction; it is cheaply and simply operated; it keeps potatoes with a minimum loss from rots; and it gives them good shipping qualities. The committee strongly recommends this type of house to the people of Texas.

B. Youngblood,
Director of Texas Agricultural Experiment Station.

STORAGE AND DISEASES OF THE SWEET POTATO IN TEXAS

DESCRIPTION OF THE HOUSE.

UNIT HOUSE.

The house here presented is a 5000-bushel house and is designed as a unit system. A comparatively small unit has been chosen because the large unit houses (capacity 10,000 to 100,000 bushels) makes successful storage much more difficult. In such houses the losses from rots are often very heavy. The 5000-bushel unit house is advocated because in that unit of bulk it is possible to make use of all the natural conditions of ventilation, and, with proper management, to reduce the losses from rots to a minimum.

Where a storage capacity of 10,000 bushels is desired, two units of 5000 bushels each may be used. These can either be built separately, or the building made twice as long. In the latter case the cost of one end wall is saved and the separating wall can be built more cheaply as the only material then needed is a layer of building paper and shiplap on each side of the studding instead of two layers of shiplap. This same arrangement can also be carried out with the larger bulks of 15,000 bushels and over. Where the houses cannot be built end to end they should be separated altogether and a space of not less than twenty feet should be left between them. The dimensions of the 500-bushel house are 59 feet ten inches by 26 feet by 11 feet four inches. The preponderance of length (Figs. 1, 13, 14, 15) is designed to secure the maximum amount of ventilation.

FRAME BUILDING.

The Texas A. and M. 5000-bushel unit house is built of lumber (Fig. 1), for the reason that this material has been thoroughly tested out and has given satisfaction. Moreover, it is the easiest building material to secure and the average carpenter can easily handle it. The house is constructed on piers, which extend about two feet above ground (Figs. 1, 14, 15, 18, 22). This arrangement allows the necessary floor ventilation, which is a distinct feature of this type of house. To protect the house against severe cold spells, outer drop-doors on the north and west sides reaching from the baseboard to the ground are desirable. These are raised or lowered as the weather conditions demand. They are, however, merely an extra precaution against the "northers" which sometimes occur in certan parts of Texas. For further details of the construction of the house see Fig. 1.

VENTILATORS.

The arrangements of floor ventilators (Figs. 5, 9, 33, 36, 37), windows (Figs. 1, 14, 15, 31), doors (Figs. 1, 15, 31), and ceiling ventilators

(Figs. 1, 14, 15, 16) are distinct features of the house. Any or all of these ventilators may be opened or closed when it is necessary to admit or exclude air currents.

CUPOLA.

The cupola (Figs. 1, 14, 15) solves the roof ventilation problem by offering a large free opening for the escape of moisture-laden, or hot air, and at the same time by its construction protecting the interior of the building from rain or snow. The opening into the cupola is controlled by means of doors in the ceiling of the house (Fig. 16).

FLUE AND STOVE.

Another distinct and important feature of this house is the method of heating and air circulation, which is accomplished by means of a stove and flue (Figs. 12, 15, 20, 33). This is really an adaptation from the modern system of heating schoolhouses. The features of this system of heating is an opening under the stove, through which the outdoor air enters from under the house. The air then passes around a jacketed stove, where it becomes heated and dried in contact with the stove. Since warm air is lighter, it will naturally rise to the ceiling and spread to all parts of the house. As it absorbs moisture from the inside air, it becomes cooler and heavier and falls to the floor, whence it escapes by suction through the bottom openings of the flue. By this method a constant and strong circulation of warm dry air may be maintained whenever damp or cold weather makes it necessary to keep windows and ventilators closed.

BIN CONSTRUCTION.

The bins are divided into four quarters (Figs 2, 21 to 27, 30, 32), two above and two below. This division causes the potatoes to be in small bulk and thus facilitates the curing process. The bins are also raised above the floor so as to allow circulation of air from underneath.

Where it is not desired to store in bins the same house may be utilized for storing in hampers (Figs. 10 and 11), baskets or crates. For this purpose slatted platforms covering the same floor space as the bins may be built (Fig. 35), upon which the containers are placed. Where the bins are left out the cost of the house is considerably reduced. Another advantage of storing in containers in place of bins is that after the potatoes have been shipped, the empty house can be more conveniently utilized for other purposes. Still another advantage of storing in hampers is in the saving of unnecessary handling, thereby reducing the chances of bruising. Furthermore, each hamper or container is really a miniature bin containing a minimum of bulk, and receiving a maximum amount of ventilation.

LOADING PLATFORM.

In connection with the outside of the house there is a loading platform (Figs. 3, 14). This is built to facilitate the unloading of the

potatoes from the wagon into the house, or in taking the potatoes from the house for shipment.

BILLS OF MATERIAL FOR THE TEXAS A. AND M. SWEET POTATO HOUSE.

HOUSE ONLY

Material	Size	Required
Piers	As detailed	40
Platform Posts	As detailed	8
Chimney Base	As detailed	1
Sills, Floor—		
6″ x 12″		120 Ft.
9″ x 12″		180 Ft.
Joists, Floor—		
3″ x 12″	14′—0″	55
Wall Stops—		
2″ x 4″	22′—0″	70
Cupola Studs—		
2″ x 4″	16′—0″	12
Plate, Wall—		
2″ x 4″	16′—0″	24
Plate, Cupola—		
2″ x 4″	10′—0″	12
Joists, Ceiling—		
2″ x 4″	14′—0″	30
Ties, Overhead—		
2″ x 4″	16′—0″	30
Rafters, H.—		
2″ x 6″	18′—0″	64
Rafters, Cupola—		
2″ x 4″	16′—0″	12
Shiplap—		
Floor		3500
Ceiling		3600
Walls, Inside		4800
Walls, Outside		2800
Roof		2400
Building Paper		1600 Yds.
Drop Siding	No. 117	2000
Shiplap	Siding	
1″ x 10 feet		1100
Con. Window Sill—		
2″ x 6″	16′—0″	12
Shingles		16,000
Windows—		
4 light	15″ x 30″	
1 3-8 Check	Rail and lock	16
Gable Sash—		
4 light	10″ x 12″	2
Sash Weight		32
Common Brick		4500
Heater—		
Strap Hinges	6″	200
Pulleys	1″	6
Rope		100 Ft.
Paint		2 Coats
Nails		400 Lbs.
Bridging—		
1″ x 4″		640 Ft.
Loading Platform—		
4″ x 10″	20′—0″	2
2″ x 6″	8′—0″	40
Steps	See detail	

BIN STORAGE

Material	Size	Required
Studding—		
2″ x 6″	16′—0″	52
2″ x 6″	12′—0″	78
Bin Joists—		
2″ x 6″	16′—0″	96
Slats—		
1″ x 6″	16′—0″	1100 Pc.
Spacers—		
2″ x 4″	16′—0″	20
1″ x 2″	16′—0″	50
Shiplap—	Stove Aisle—	
1″ x 6″	16′—0″	24
Nails		200 Lbs.
Hinges	6″	164

HAMPERS, BASKETS OR CRATE STORAGE

Material	Size	Required
	Posts marked P on Plans	
2″ x 6″	12′—0″	40
Slats—		
1″ x 4″	16′—0″	200
Platform—	Joists—	
2″ x 8″	16′—0″	25
Nails—		
Bridging	1″ x 4″	400 Ft.

PREPARING THE HOUSE FOR STORAGE.

Some time before harvesting and during any slack time in the summer, the house should be carefully overhauled and any necessary repairs made. Broken windows should be replaced and all doors, ventilators, and other outside openings made to fit tight. Any leaks in the roof should be repaired and all rat holes closed. If the bins need repair they should also receive attention. The stove and stove pipe should be overhauled and cleaned.

The house should also receive a thorough cleaning so as to remove all the dust and refuse left over from the previous crop. The indoor walls and woodwork, as well as the floor, should be disinfected by spraying with a solution of concentrated lime sulphur. To make this, mix 15 pounds of sulphur and 7½ pounds of stone (unslacked) lime in sufficient hot water to slake the lime. When slaked, add to a barrel of water. One barrel of this mixture will be sufficient for the 5000-bushel house. The spraying may be done with an ordinary bucket pump having a long extension rod and an ordinary nozzle.

If there are objections to the use of lime sulphur on account of its odor, copper sulphate, also known as blue vitriol or blue stone, may be used instead. This is made in the proportion of 5 pounds of copper sulphate dissolved in a 50-gallon barrel of water. A good way to dissolve the copper sulphate is to place it in a small sack and suspend it in a barrel of water over night. Only wooden buckets or barrels should be used, as the solution will corrode metal. Copper sulphate solution is poisonous when taken internally; hence it should not be left where children or farm animals may have access to it.

A more thorough method of disinfecting sweet potato houses is by the formaldehyde gas method. Unfortunately this chemical is very expensive at this time, which practically prohibits its use for the present. The method is as follows: For each thousand cubic feet of storage house space buy three pints of 40 per cent. formaldehyde and 23 ounces of potassium permanganate. Use about three three-gallon crocks, or larger, and distribute them on the floor of the house. Then divide the permanganate and the formaldehyde separately into as many parts as there are crocks, placing the permanganate in the crocks and the formaldehyde in cans or cups, one beside each crock. Close the entire house tight except a door to leave by. Then beginning with the crock farthest from the door and working fast, pour the formaldehyde into each crock. Leave the house at once, closing the door securely behind you. As a result of the chemical action with the permanganate, fumes will fill the house and kill all the germs, insects, rats or mice that may be present. The house should be kept closed for forty-eight hours to allow the fumes to act, after which it is opened and allowed to air. In opening, one should be careful not to inhale any of the fumes. When this method of fumigation is practiced, the operation had best be performed by two persons so that in case of accident the other will be on hand.

The burning of sulphur in the house is effective in controlling mites and in killing rats, but it will not kill the germs that cause disease on sweet potatoes.

HARVESTING.

A great deal of the success in storing sweet potatoes depends on the way in which the crop is handled in the field. Except for early marketing, sweet potatoes should not be dug until they are well matured, as immature stock is much harder to cure and to keep. Sometimes an early frost will injure the crop, but ordinarily the season in Texas is such as to allow full maturity. It is never safe to take chances on a late frost. Where a dry summer precedes a wet fall most growers are often inclined to delay digging until too late in the season. Where this is done there is danger that the potatoes will become frost bitten in the field. If the vines are merely frosted, the potatoes are still safe for storing, but they should be dug as soon as possible. On the other hand, if the frost has killed the vines to the point of injuring the tips of the potatoes there is little chance of the crop keeping well. If this condition arises, the potatoes should be sold immediately for early use.

The natural yellowing of the foliage is usually a good indication that the potatoes are ready to be harvested. Another test for maturity is to cut several potatoes and if the cut surfaces become white and dry in a short time the potatoes are mature; on the other hand, if the cut surface remains moist and turns to a darker color, it is an indication that the potato is immature. Furthermore, the skin of the mature potato cannot be rubbed off as easily as that of an immature one.

The potatoes should be dug as carefully as possible, avoiding all unnecessary bruising. For this purpose a plow with two rolling colters attached to the beam to cut the vines, and several steel prongs on the

mold-board to separate the soil and the vines from the potatoes makes a very handy implement for digging. A "middle buster" with rolling colters also does satisfactory work. A common mistake is made in not going deep enough with the plow, and as a result many of the potatoes are cut or bruised. The best time to dig is during warm, dry weather, since the potatoes, especially the bruised ones, are more likely to rot when dug while wet; besides, the potatoes dug during wet weather will be more watery, and hence harder to cure. However, in wet seasons the grower will often be forced to dig when potatoes are wet and muddy. Under these conditions sweet potatoes require extra care in that they must be dried quickly and the moisture not allowed to stay on the potatoes for any considerable length of time. Wet potatoes should never be stored in great bulk, but should be spread out in small quantities if possible. It is poor policy to dig the potatoes late in the evening and allow them to remain uncovered during the night in the field, as they may be injured by frost or rain. Neither is it wise to dig early in the morning when the ground is more or less cool and the vines wet with dew.

The best time to dig is after the sun is well up and not later than three or four in the afternoon, or until such a time that the grower will be able to pick up before night all that he has dug. It is not safe to allow the potatoes to remain exposed long to a hot sun, although a mild sunlight will help them to dry off.

The potatoes should be graded while being picked up. To do so will save time, labor, and excessive handling. Some of the pickers should gather the No. 1's and others the No. 2's, and still others the bruised, the cut, and the jumbo grades. Mechanical graders are being perfected, and no doubt they will play an important part in the future in the proper grading of sweet potatoes. Grades are described more fully on page 17.

Potatoes should be handled with extreme care and as little as possible if they are expected to keep well. Where storing is done in hampers, baskets or crates, it is best to gather the roots in these containers and place in the house as soon as possible. They should never be handled in sacks or hauled loose in a wagon box. When the potatoes are hauled from the field to the house they should be placed directly in a spring wagon and carried over the smoothest road, the aim, of course, being to avoid unnecessary shaking and jarring, which injures the potatoes. It is also necessary to fill the crates and to place the cover tightly on top so as to prevent jolting. If a spring wagon is not available, a deep layer of straw or hay should be made in the wagon box.

It is very important to prevent bruising, which is mostly caused by rough handling, because bruised potatoes are harder to keep, and even if they go through the storage period without rotting, they are practically unmarketable on account of their unsightly appearance.

MANAGEMENT OF THE POTATO HOUSE.

Successful sweet potato storage depends, it is true, on the house, but intelligent management of the house is a factor which cannot be ignored. It is hoped that those who contemplate adopting the A. and M. unit

system will give it a careful study. Good management, after all, resolves itself down to common sense. Where potatoes fail to keep, it is easy enough to throw the blame on the house, which cannot defend itself, but in many cases the fault is due to mismanagement.

Enough wages should be paid to secure a first-class manager for storage houses. Such money is well spent. It does not take the loss of many bushels of potatoes to amount to more than the extra salary required to secure a competent manager. The Extension Service of the A. and M. College of Texas is ready to give assistance, so far as possible, to the manager of any sweet potato house in Texas.

CURING AND CARE OF SWEET POTATOES IN STORAGE.

The problem of keeping sweet potatoes is the problem of preventing rot-producing fungi from growing on them. Since these destructive forms of life require moisture for their development the most important factor in preventing their growth is a thoroughly dry surface. During the first ten days or two weeks of storage a great deal of moisture is given off, which generally amounts to 6 or 8 per cent. of the original weight of the sweet potatoes. This stage of greatest evaporation is called the curing period. After this, a small amount of evaporation continually goes on, but is easily handled.

While it is important at all times that the moisture given off by the potatoes should be driven out of the house, it is especially important during the curing period. In the Texas A. and M. house this is easily accomplished by means of heat supplied by a stove, and through ventilation obtained by means of special ventilators. The heat creates air currents in the house and aids in the drying of the potatoes, for when the air that is taken in from the outside is warmed, it is given a greater capacity for taking up moisture. In the A. and M. unit house the heat is so distributed that the temperature is practically the same in all parts of the house, except immediately under the ceiling where there are no potatoes (see chart, Fig. 34).

While a certain amount of heat is essential, this requirement is often misunderstood in the sense that potato houses are frequently overheated. Warm air is not necessarily dry and it will not cure potatoes unless it is dry. After dry air has circulated around the potatoes during curing, it will be moist even though still quite warm, and must be allowed to escape with its load of moisture. The temperature during curing should run from 75 to 80 degrees Fahrenheit, and this same temperature should be maintained, as far as possible, until complete curing is indicated. The length of the curing period depends on the condition of the potatoes. If they are grown during a season of high rainfall, and dug during wet weather, they will naturally require longer curing than those grown during the dry season and dug when dry. Generally speaking, the curing period lasts from ten to eighteen days, two weeks being an average. It is relatively easy to tell when potatoes are cured by merely rubbing the skin. When it clings more or less firmly and feels leathery to the touch, it indicates complete curing. On the other hand, if the skin rubs off easily the curing period should be extended.

As soon as the potatoes have been cured the temperature should be

lowered to 55 degrees Fahrenheit. This temperature should be maintained as nearly as possible during the remainder of the storage period by using the proper judgment in opening and closing the ventilators and windows.

The first essential of curing sweet potatoes is to keep their surface dry. For this purpose the heating and ventilating system of the A. and M. unit house is very efficient.

The following directions may serve as a guide during curing:

While the potatoes are being brought to the house, a fire should be kept in the stove, in order to take care of any sweating of the potatoes. This is especially important if the outside air is damp. If the weather is dry and warm with a temperature of 75 to 80 degrees, it is not necessary to keep up a fire while the house is being filled. In that case all of the doors, windows and ventilators should be kept open.

After the house has been filled, which should be within ten days to two weeks, the main curing period starts. For this purpose the house should be completely closed, except the ventilator under the stove and the two ventilators at the bottom of the flue. A fire should be kept in the stove day and night, maintaining a uniform temperature of 75 to 80 degrees, until the potatoes are cured, that is, until the skin feels leathery and does not peel off.

By thus keeping the house closed during the curing period a large volume of air is drawn in from under the house and is heated by the stove; then it rises to the ceiling and spreads out evenly to all parts of the house, being drawn out through the openings in the flue. By this method a good circulation of warm air is maintained in the house and all of the air has to circulate around the potatoes before it can escape through the flue, thereby curing all of the potatoes uniformly. (See Fig. 34, which illustrates the circulation.)

In case the weather during curing is dry and warm, having the desired temperature of 75 to 80 degrees, the fire in the stove is not necessary, but instead, all of the ventilators and windows can be opened, as the dry, warm air from the outside will serve exactly the same purpose in curing as the air heated by the stove. By consulting the thermometer and hygrometer the manager can easily tell when to use the stove and when to take advantage of the outside air. The first method, that is, by keeping the house closed, works well during wet, cold, or damp weather and the latter during warm, dry weather.

If at any time the temperature rises above 80 degrees the house should be cooled by opening as many of the ceiling ventilators and those in the aisles as necessary. This creates a draft which will soon reduce the temperature. However, if the heating is closely watched such a condition should not arise.

In order to maintain the proper temperature in the potato house one cannot depend on mere guesswork. It is, therefore, necessary to have three or four reliable thermometers distributed in various parts of the house, as otherwise it is impossible to know that the desired temperature is being maintained. In addition to thermometers, one or two hygrometers, which indicate the relative humidity of the air, are very useful in the proper operation of a sweet potato storage house. The form of hygrometer shown in figure 41 indicates the amount of moist-

ure in the air. For example, a reading of 60 indicates that the air around the hygrometer is 60 per cent. saturated. The danger point in the potato house is about 70. If the reading is near or above 70 it indicates that the air is too moist. The reading should be maintained below 70, and should generally run between 40 and 70. Both thermometers and hygrometers should be hung up at a height of about five feet. In addition to the indoor thermometers and hygrometers it is desirable to have a thermometer and hygrometer outdoors to indicate the temperature and moisture in order to take advantage of all favorable outdoor conditions.

STORAGE PERIOD AFTER CURING.

It has already been stated that as soon as the potatoes have been cured the temperature should be reduced to 55 degrees Fahrenheit and kept as nearly at that point as possible. This is accomplished by the proper handling of the ventilators and windows. It is usually quite easy to keep this type of house cool and dry. During a clear and dry day with the outside temperature registering from 55 to 60 degrees, all ventilators should be opened so that plenty of fresh air can circulate through the house. Whenever the weather is rainy or the air is damp, it is necessary to keep the house well closed so as not to let in any outside air.

The flue ventilators should always be kept open except during cold or wet weather, as thereby a constant circulation of air will be maintained in the house. It is important to have the flue ventilators and the ventilator under the stove open, whenever a fire is required in the stove, except during very cold weather, when all ventilators should be kept closed.

In case weather conditions are such in the fall that it is hard to keep the temperature down to 55 degrees, the house can be opened during part of the night, especially on dry and clear nights, but, of course, this should not be done during damp weather. The manager of the house should have no trouble in keeping the house dry and cool if he uses good judgment in handling the ventilators.

The reading of the hygrometer in the house and outdoors is a good guide as to whether or not to open the ventilators. The house should be kept closed whenever the hygrometer indicates a greater humidity on the outside than on the inside. The temperature of the house should never be allowed to go below 45 degrees, and it is always safest to start a small fire whenever the temperature goes down to 49 or 50 degrees. During cold weather, if the house seems rather moist as indicated by the reading of the hygrometer, one can easily drive off this moisture by starting a fire in the stove, being careful, however, not to let the temperature rise above 60 degrees.

DISEASES OF SWEET POTATOES IN STORAGE.

At the beginning of this bulletin it was stated that the storage problem is mainly one of diseases. The manager of the potato house should never lose sight of this fact. The underlying causes of the greatest

losses from rots are usually found in improperly constructed houses and poor management. There are a large number of diseases capable of rotting the sweet potato. In fact, the latter may become a real garden for the growth of various fungi. However, we shall confine our discussion only to the two most important diseases which the storage man has to contend with, namely, soft rot and black rot. Those who wish to get more extended information on diseases should refer to bulletin No. 249 of the Texas Agricultural Experiment Station, dealing with field diseases.

SOFT ROT.

It is no exaggeration to state that in some sweet potato houses which lose heavily from rots, most of the loss may be attributed to soft rot. This disease is well known to the farmers who store sweet potatoes. It is generally known as mush rot, vinegar rot, or leak. As its name indicates, it cannot be mistaken for any other disease. Rotted potatoes become soft and mushy (Fig. 39) and at the least touch of the finger or from pressure break open, and a clear, brownish liquid comes out. A few days afterward there will be noticed in the house numerous small gnats. They are merely little flies which lay their eggs in the rotted potatoes. Some people believe that these gnats are the cause of the rot, but they are only an indication of the presence of soft rot in the house. Frequently also the potatoes in the bin appear wet as though water had been poured on them. This, too, is an indication that in that vicinity there are one or more soft rotted potatoes which have broken open and spilled their juice on the healthy potatoes underneath; and also become covered with a whiskered growth of the causal fungus (Fig. 39). If a soft rotted potato remains in the bin untouched until the end of the storage season, it will usually lose all its moisture and become very hard, in which case the term dry rot is often applied to it. In fact, many growers mistakenly believe that this dry rot has no connection with the soft rot, but as already stated, this is the final stage of the disease. Usually a house full of potatoes that smells of vinegar indicates the presence of considerable soft rot. This condition may be met with in houses which lack the necessary means of ventilation, in which case it is not uncommon to find the moisture actually dripping from the inside walls of the house. Such houses can, of course, be corrected by the installation of more doors, windows, and ventilators.

The cause of soft rot is a fungus. It is the ordinary bread mold fungus which is often found growing on bread when kept in a tightly closed vessel. This same fungus also causes a soft rot of the Irish potato. The spores, which are very small and from which the fungus grows, may be found floating in the air and clinging to the dust that is brought in with the potatoes from the field. As long as the potato house is kept perfectly dry and properly ventilated these spores will not germinate, just as seeds of higher plants will lie dormant in a dry soil. As soon as the air in the house becomes heavily laden with moisture and this air is permitted to remain in the house for any length of time, the spores will germinate, penetrate the sweet potato and produce the mush rot. Bruised potatoes will naturally rot quicker than the sound ones, as the bruises or cuts merely present an ideal opening for these

germniated spores to penetrate. As a matter of fact mush rot or soft rot is seldom found in properly ventilated houses and where care and attention is given to the house. On the other hand, where a high percentage of soft rot is met with, it may be taken for granted that either badly bruised or frozen potatoes have been put in the house, or that the house was overheated or not ventilated sufficiently. While soft rot is an important disease in the potato house, it can be readily controlled by bringing in well handled potatoes and by giving due attention to the heating and ventilation.

The spores of soft rot are found everywhere in the air and the dust and do not necessarily have to be brought in from the field, although they are met with there.

BLACK ROT.

Black rot is next in importance to soft rot. This disease is primarily a field trouble and when found in storage is always traceable to disease-infected soil in the field. It is possible under careful management to keep down the spread of this trouble to a minimum. Overheating in storage will nearly always encourage the spread of the disease, if infected potatoes have been brought in from the field. Usually black rot will not spread in the house as long as the skin of the potato covering the black rot spot is unbroken. However, as soon as the skin ruptures there immediately develops the fruiting stage of the fungus. Under sufficient heat and moisture these spores will ooze out in little yellowish droplets on the surface of the potato. The numerous mites usually present in the house are very fond of and will come to feed on this yellowish liquid, which contains the spores or seed of the fungus. In feeding, their bodies become smeared with the black rot spores which they carry about and spread from potato to potato. It is possible so to manage the house as not only to minimize the spreading of the spots on the potatoes already affected but also to prevent the cracking of the skin and development of this fruiting stage.

Black rot itself is only a skin-deep disease (Fig. 40). However, its presence is very detrimental to the potato as it leaves a decidedly bitter quinine-like taste, and makes the potatoes when cooked unfit for eating purposes. Besides, black rot often opens the way to soft rot, as it deadens the disease-resisting power of the potato.

Black rot in the house may be controlled by giving due attention to the temperature; by seeing that during the curing period the temperature never rises above 80 degrees; and after curing by maintaining a temperature of about 55 degrees Fahrenheit.

Moreover, if the crop is grown on uninfected soil, and carefully selected and treated seed are used, there should be little damage from black rot.

There are, of course, numerous other diseases which may attack the sweet potato in storage, but usually these are secondary and follow in the wake of either black rot or soft rot, and because they are not sufficiently important they are here omitted.

The managers of potato houses should be cautioned never to go through the bin with the view of sorting out bad potatoes. They will scatter spores of disease producing fungi and hence will do more harm

than good. It is much better not to handle them until they are ready for shippig.

THE BUSINESS SIDE OF POTATO HOUSES.

The first year of the operation of a house is the most critical year. There are several reasons for this:

1. The community is liable not to produce enough potatoes to fill the house and this is especially true if the house is of large capacity. It is, therefore, well to begin with a small house and add other units from year to year as potato growing increases in popularity with the farmers.

2. Farmers must become accustomed to handling potatoes without bruising, as bruises weaken the power of the potato to resist the disease producing germs.

3. The manager not being able to fill his house with carefully handled potatoes, will be tempted to accept inferior potatoes and thus add to the difficulties of keeping down rots.

4. The manager himself will present a problem. The business of storage will be new to him. If the owner of the house is in immediate charge, or if a thoroughly capable man is hired, the business will be quickly mastered, but if an indifferent man is hired, the losses may be large. Enough wages should be paid to hire a good man and to cause him to take a real interest in the problems of storage.

As the storage period runs only about six months, the manager may be profitably employed in growing slips for sale. This is desirable for three reasons. First, it will add to the income of the house and help to pay the manager. Secondly, if the slips are properly grown, it will supply the farmers with plants free of disease and will thus cut down losses during the next storage season. Thirdly, it should also standardize the potatoes grown in the community and sold through the house.

MARKETING.

With farms located near large cities, the marketing problem is simple, and a small house on each farm is very satisfactory. When the distance from market is such that shipping by rail is necessary, sufficient potatoes must be produced and stored to fill at least one car. This can be done by a single farmer with a house on his farm or by a group of farmers co-operating in the building and in the operating of a large house located at a railway station. There are advantages in both methods.

Before being shipped the potatoes should be carefully regraded into the standard grades and all those that do not come up to the required specifications should be discarded. There is nothing more important in successful marketing than to ship carefully packed and graded products such as the market wants, thereby getting the top prices and establishing a reputation which will bring repeat orders. Consumers are willing to pay a good deal more for nice looking products than for inferior stuff, which is high at any price. Poorly graded products are not wanted by the buyers and it is poor policy to ship them. It is much

more profitable to feed this inferior stuff to the hogs than to try to sell it. Bushel baskets, hampers or crates are good containers to use for shipping sweet potatoes. They should never be shipped in sacks (Fig. 17) for fear of bruising and consequent rotting.

CARE IN SHIPPING.

Sometimes after potatoes have been perfectly cured they spoil while in the car or after they have reached the jobber on account of improper handling. One case is recorded of potatoes loaded into a car that had ice in the bunkers. The potatoes, of course, spoiled badly in transit, and after being taken from the car; and what would have been a profitable season for the house was turned into a loss, simply because the sweet potatoes were chilled by being in an iced car.

Cars should not be loaded during cold or wet weather if possible, and for long shipments during cold weather it is sometimes necessary to provide artificial heat in the car to prevent chilling. Cars should be kept dry and cool on the inside while they are conveying potatoes to market. When shipping one should give billing instructions to keep the vents in the car open during cool and dry weather and closed during cold or damp weather. The jobber who receives potatoes should store them in a room that may be kept as dry and as near a temperature of 55 degrees as possible. The retailer and consumer should store them with like care for best results. It should always be remembered that even cured potatoes are liable to rot when improperly handled after being taken out of the house.

TEXAS STANDARD GRADES FOR SWEET POTATOES.

The following grades for Texas were established by the Commissioner of Agriculture according to Chapter 181, Acts of the Regular Session of the Thirty-fifth Legislature:

Grade No. 1. This grade shall consist of sound sweet potatoes of similar varietal characteristics which are practically free from dirt or other foreign matter, frost injury, bruises, cuts, cracks and damage caused by disease or mechanical means.

The diameter shall be not less than one and three-quarters ($1\frac{3}{4}$) inches nor more than three and one-half ($3\frac{1}{2}$) inches.

Five (5) per cent. by weight by any lot may be below the least or above the greatest diameter prescribed, and in addition, five (5) per cent. by weight of such lot may be below the remaining requirements of the grade.

No. 2. This grade shall consist of sound sweet potatoes of similar varietal characteristics not meeting the requirements of grade No. 1, which are free from serious damage caused by dirt or other foreign matter, frost injury, heat, decay, bruises, cuts, scars, cracks, dry rot or other disease (including weevils), or mechanical means.

The diameter shall be not less than one and one-half ($1\frac{1}{2}$) inches. Five (5) per cent. by weight of any lot may be less than the diameter prescribed, and in addition, five (5) per cent. by weight of such lot may be below the remaining requirements of the grade.

DEFINITIONS AND EXPLANATIONS OF GRADE REQUIREMENTS.

a. "Sweet potatoes" include yams.

b. "Diameter" means the greatest dimension at right angles to any portion of a central line running through the sweet potato from stem end to root end.

c. "Practically free" means that the appearance shall not be injured to an extent readily apparent upon casual examination of the lot, and that any damage from the causes mentioned can be removed by the ordinary process of paring without appreciable increase in waste over that which would occur if the sweet potatoes were perfect.

d. "Free from serious damage" means that the appearance shall not be injured to the extent of more than 20 per cent. of the surface, and that any damage from the causes mentioned can be removed by the ordinary process of paring without increase in waste of more than 10 per cent. by weight over that which would occur if the sweet potatoes were perfect.

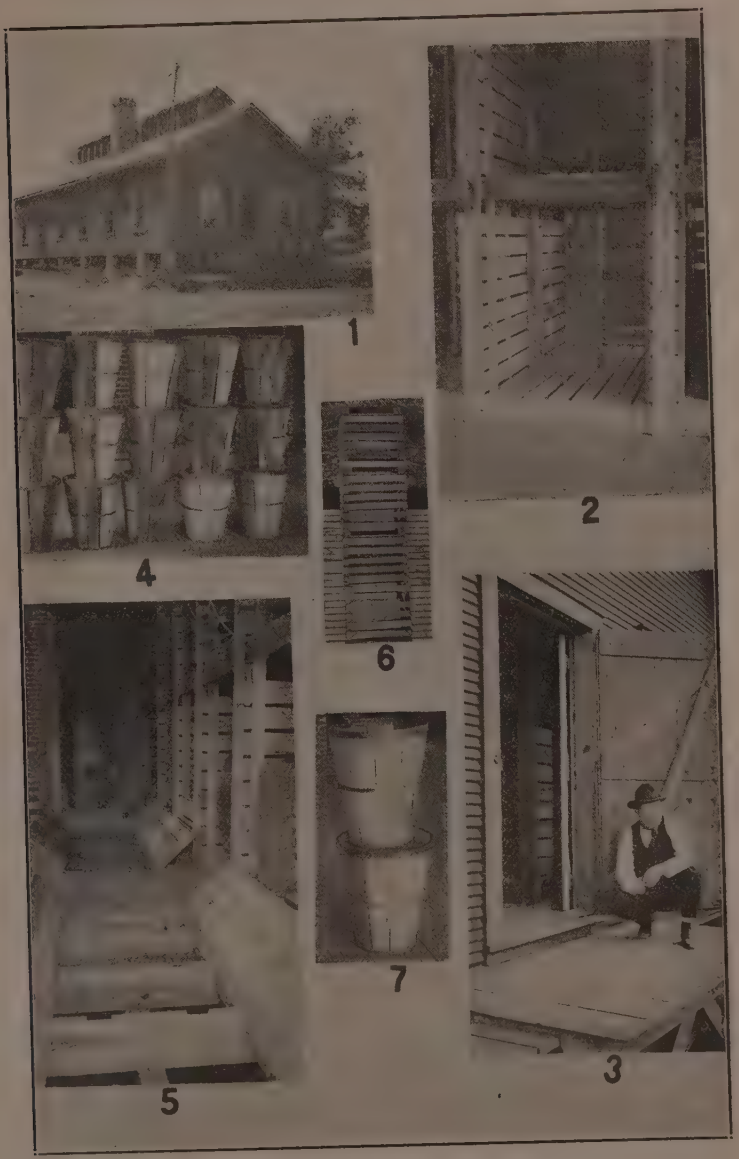


Fig. 1.—Photo showing exterior of the Texas A. and M. 5,000 bushel sweet potato house.
Fig. 2. Interior view of upper and lower bins.
Fig. 3.—Loading platform.
Fig. 4.—Poor method of stacking hampers.
Fig. 5.—Middle aisle trap door ventilators.
Fig. 6.—Sweet potato crates.
Fig. 7.—Hampers used for storing sweet potatoes.

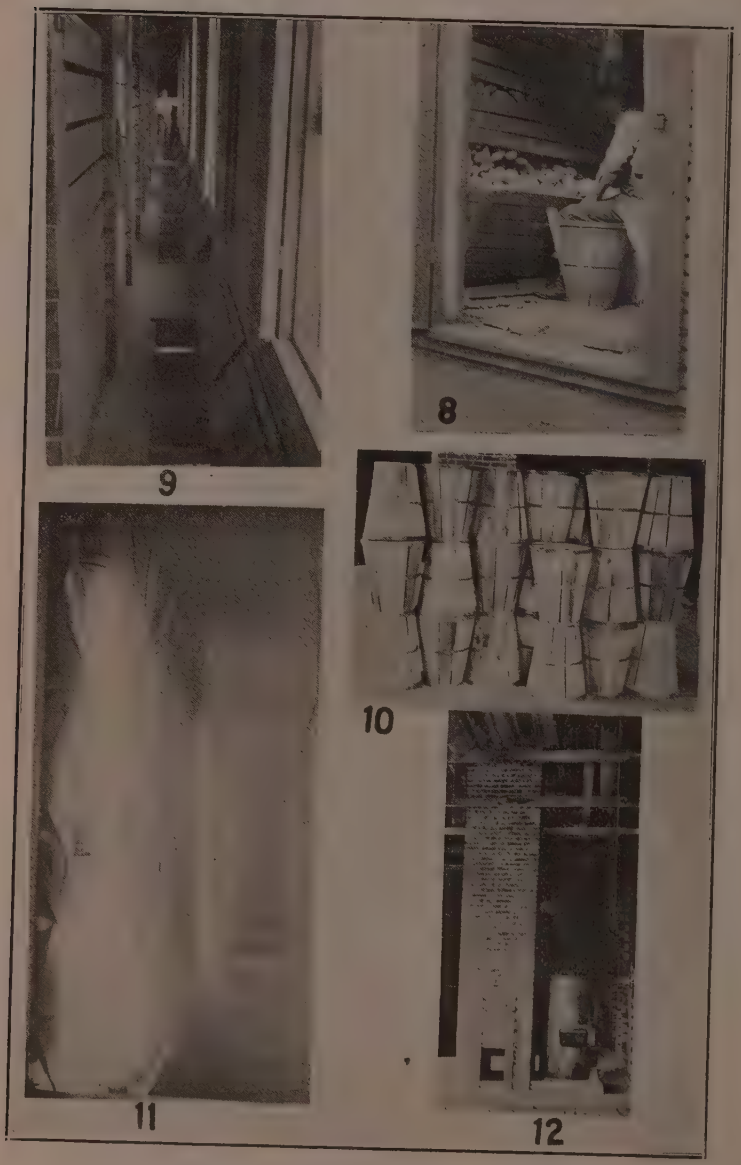


Fig. 8.—Front gate, showing how potatoes are to be taken out of bin.
Fig. 9.—Side aisle, trap door ventilation.
Figs. 10 and 11.—Correct way of stacking hampers during storage.
Fig. 12.—Showing stove and flue.

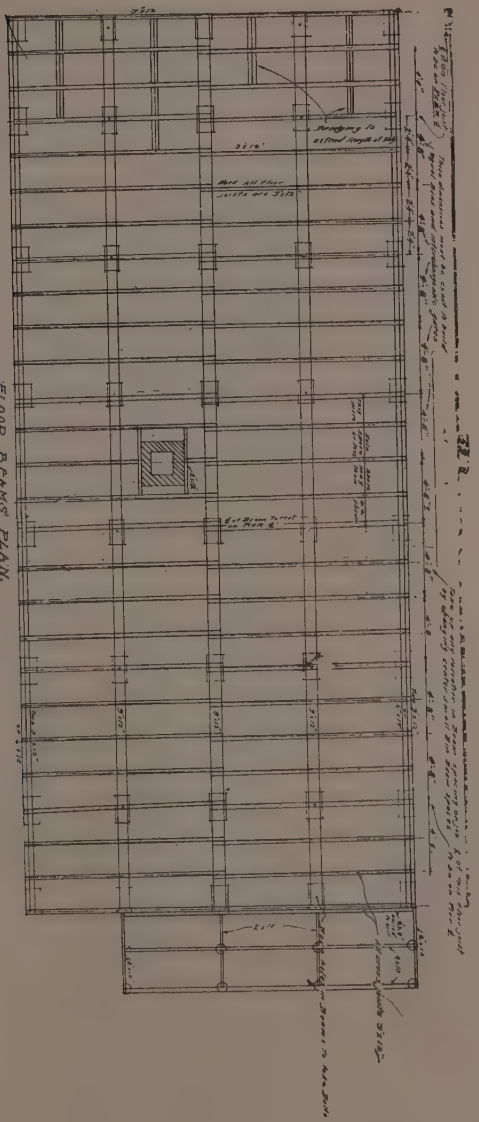


Fig. 13.—Floor Beams Plan.

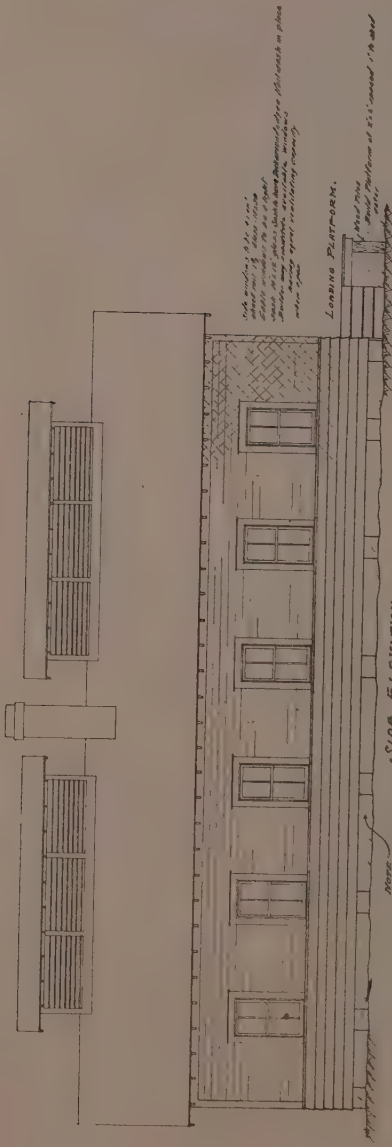


Fig. 14.—Drawing showing side elevation of Texas A. and M. 5,000 bushel house

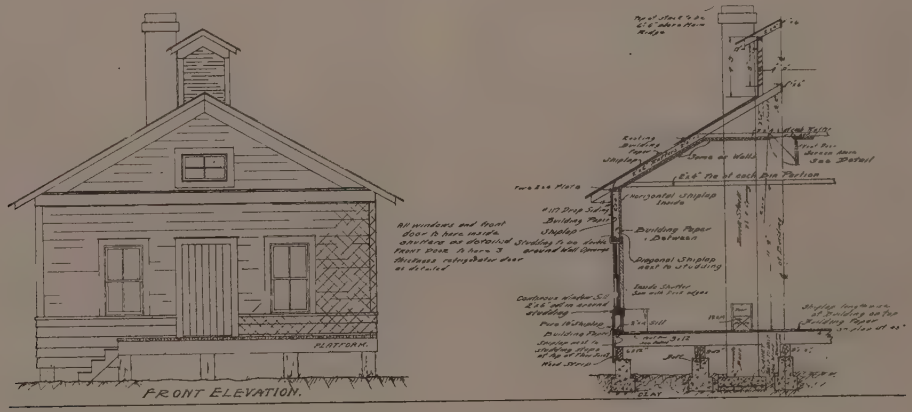
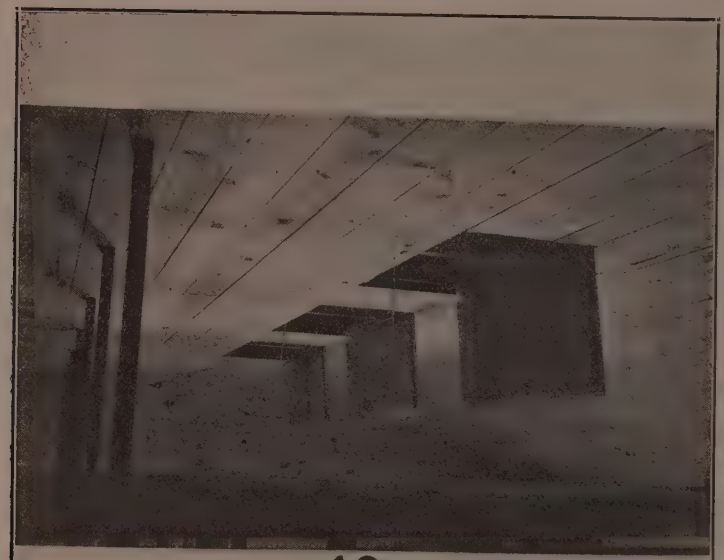


Fig. 15.—To right, showing construction of foundation, walls and flue; to left, drawing showing front elevation.



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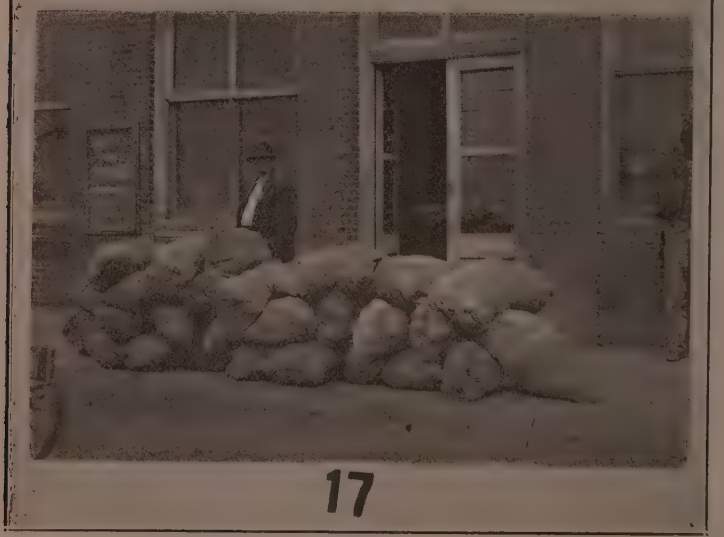
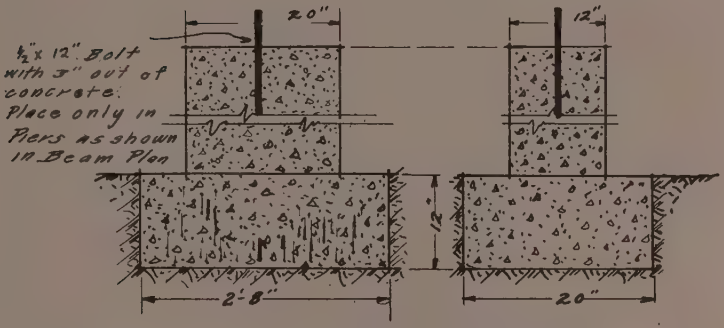


17

Fig. 16—Photo showing ceiling door vents.
Fig. 17.—Sweet potatoes ready to be shipped in sacks, a practice to be condemned.



PIER DETAIL.

Scale 1" = 1'-0"

CONCRETE MIXTURE.

CEMENT - 1 PART

ROCK - - - - 4 PARTS - 1½" MESH

SAND - - - 2 PARTS.

Platform supports to be
8" or 12" posts driven to clay
Front posts as Detailed

POST DETAIL
Showing cut for Beam.
Scale 1" = 1'-0"

Fig. 18.—Upper part, drawing showing pier detail; lower part, showing post detail.

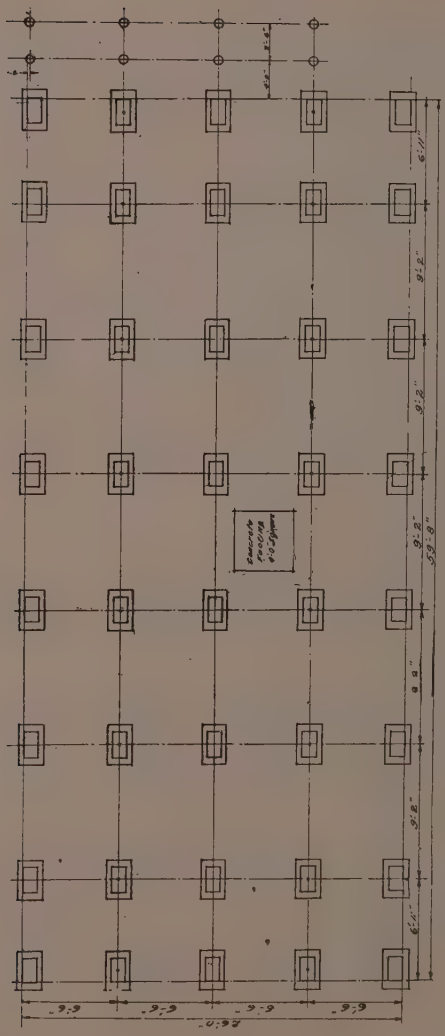


Fig. 19.—Drawing showing foundation plan.

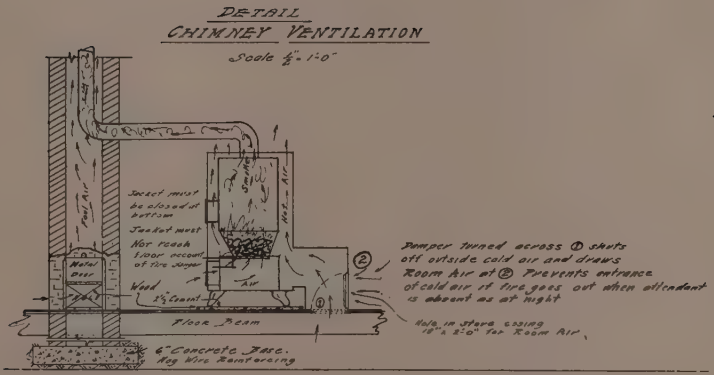

DETAIL
CHIMNEY VENTILATION
Scale ½"-1'-0"
Damper must be closed at bottom
Jacket must Not reach floor account of fire danger
Metal Door
Wood
1½ Cement
Air
Floor Beam
6" Concrete Base. Reg Wire Reinforcing
Damper turned across ① shuts off outside cold air and draws Room Air at ② Prevents entrance of cold air if fire goes out when attendant is absent as at night
Hole in Stove casing 18" x 2'-0" for Room Air

Fig. 20.—Drawing showing detail chimney ventilation.

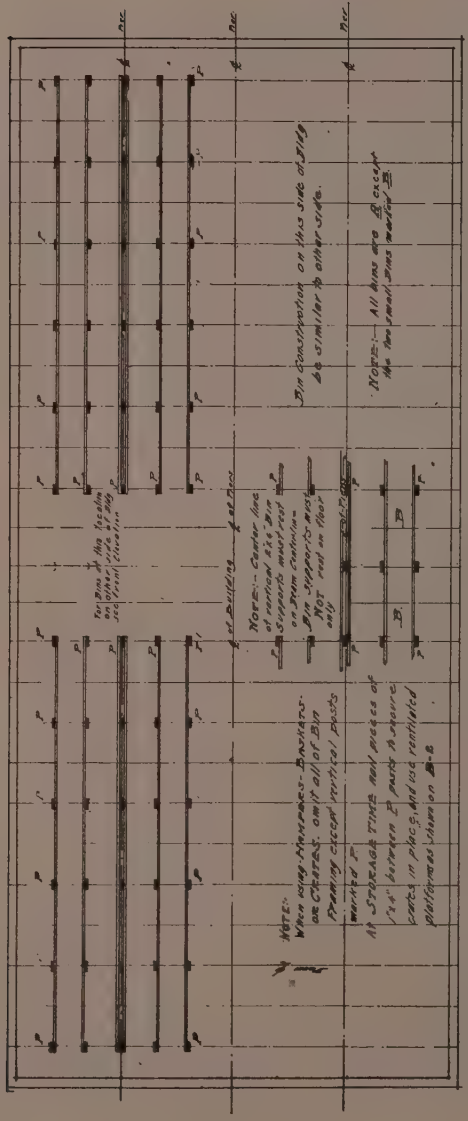


Fig. 21.—Drawing showing floor plan of bin framing.

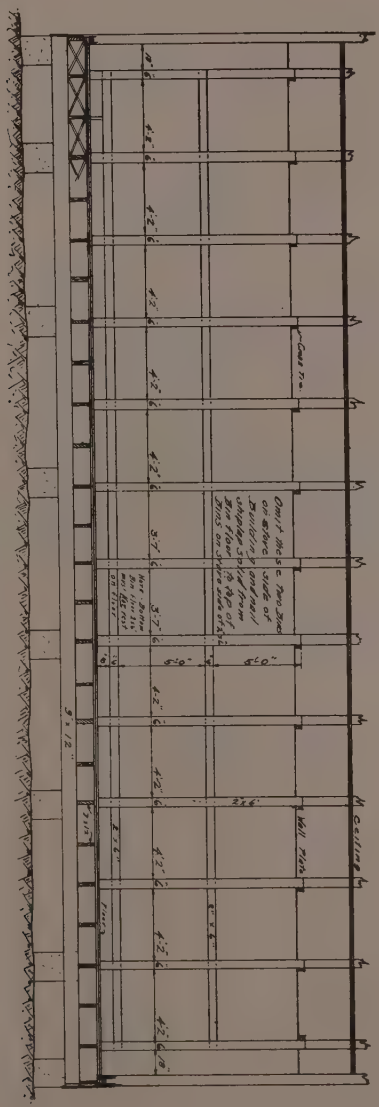
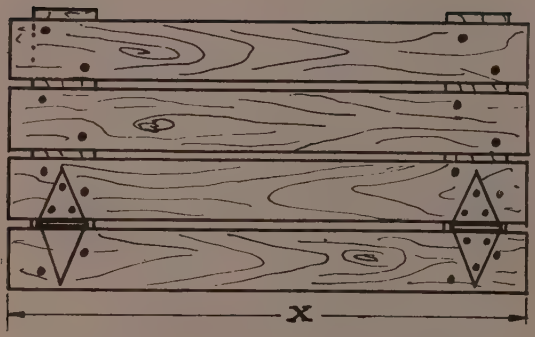


Fig. 22.—Drawing showing front elevation of bin framing.



Bin	X	Required
A	4'-5"	40

Fig. 23.—Drawing showing bottom gate, outer bins.

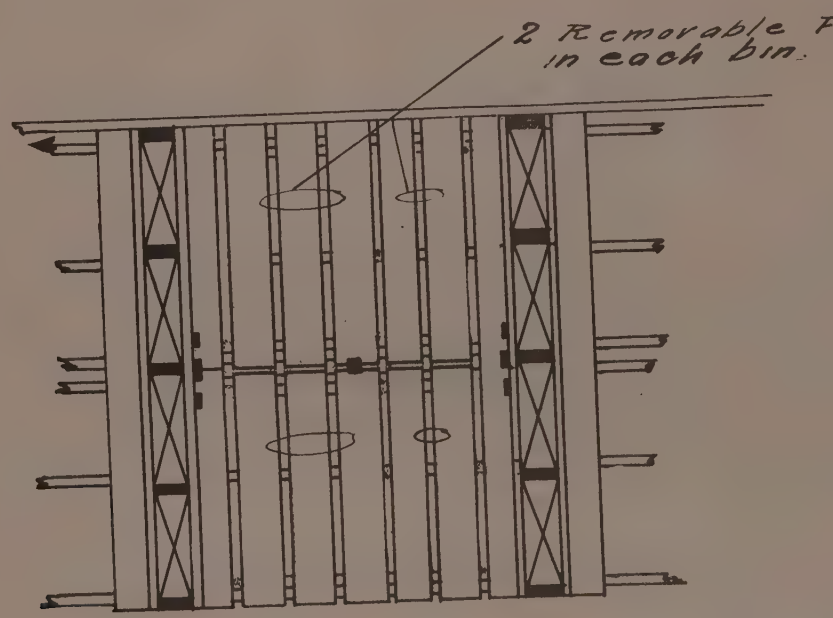


Fig. 24.—Drawing showing floor plan of bin.

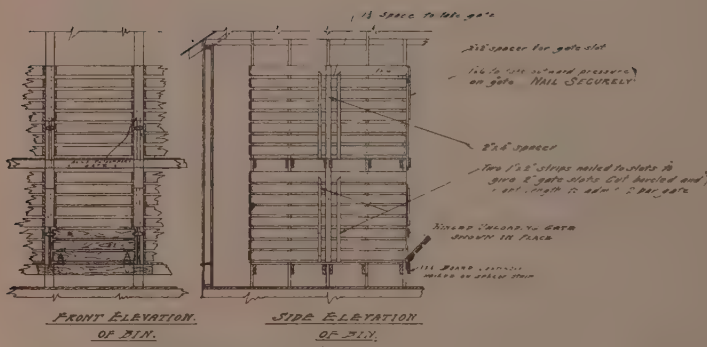
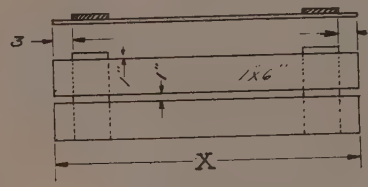


Fig. 25.—To right, showing side elevation of bin; to left, front elevation of bin.



SLIDING MIDDLE GATES.

Dims	X	Required
A	3'-11½"	160

SLIDING OUTER GATES.

A	4'-5½"	80
B	To Fit	8

NOTE:—
All Gate dimensions must be adjusted to meet conditions on job

Fig. 27.—To right, sliding middle and outer gates; to left, sliding gate.

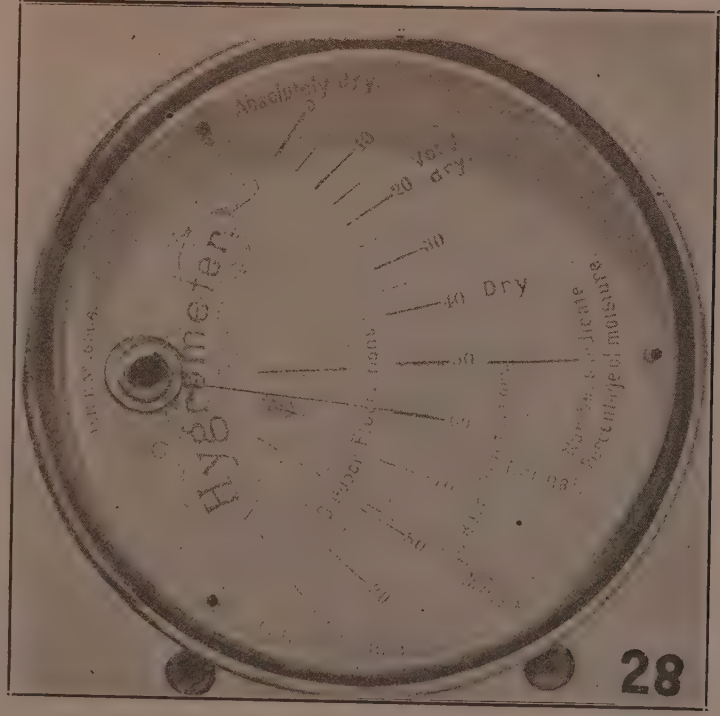
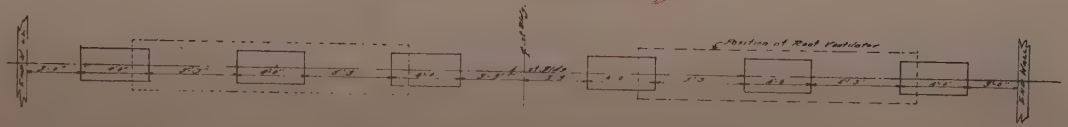
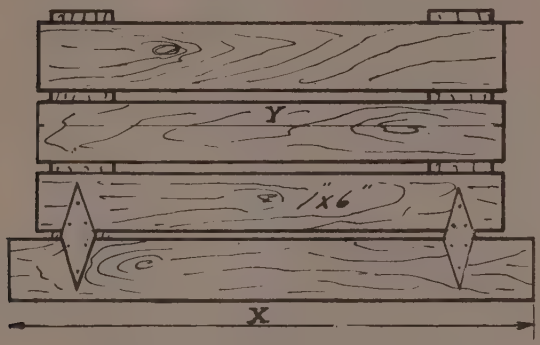


Fig. 28.—Hydrometer.



PLAN OF CEILING DOOR LOCATION.



BOTTOM GATE
Scale 1"=1'-0"
INNER AND B BINS.

Bins	X	Y	No.
A	3'-11"	3'-7"	40.
B	TO	FIT.	4

Fig. 30.—Drawing showing bottom gate.

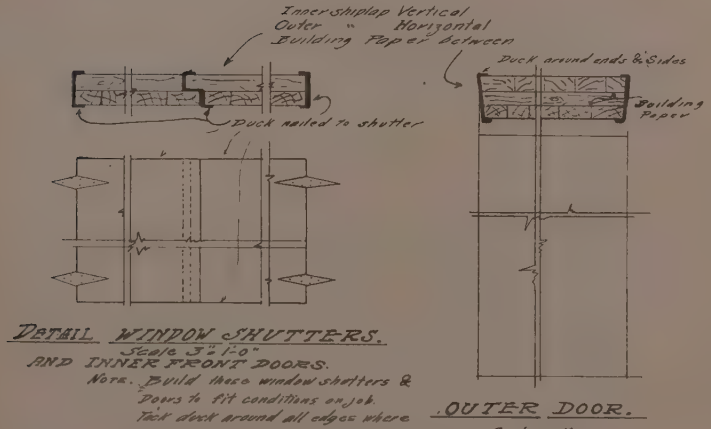
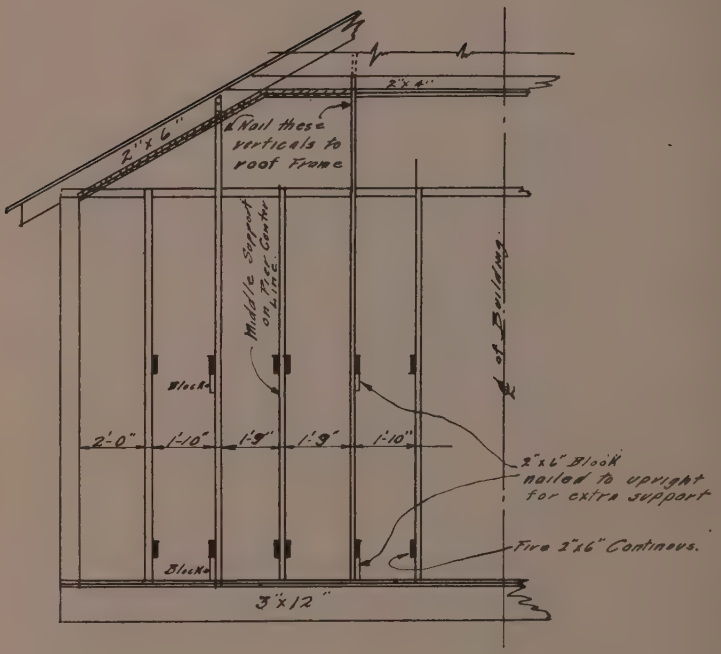

Inner Shiplap Vertical
Outer " Horizontal
Building Paper between
Duck around ends & Sides
Building Paper
Duck nailed to shutter
DETAIL WINDOW SHUTTERS.
Scale 3"=1'-0"
AND INNER FRONT DOORS.
Note. Build these window shutters & Doors to fit conditions on job. Tack duck around all edges where cold air might get thru. Make allowance when cutting lumber for duck layer-to avoid a cramp fit
OUTER DOOR.
Scale - None.

Fig. 31.—Drawing showing detail of window shutters and of outer door.



END ELEVATION.

BIN FRAMING.

Fig. 32.—Drawing showing end elevation, bin framing.

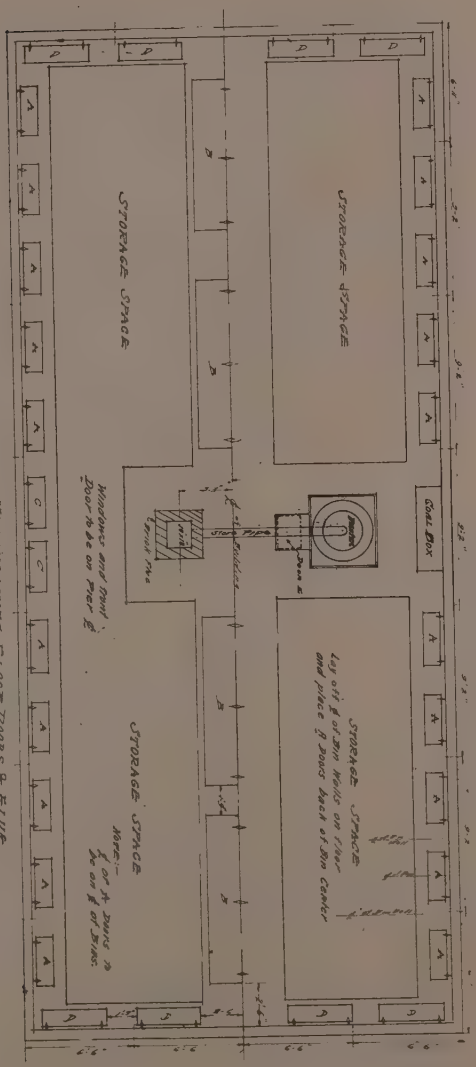
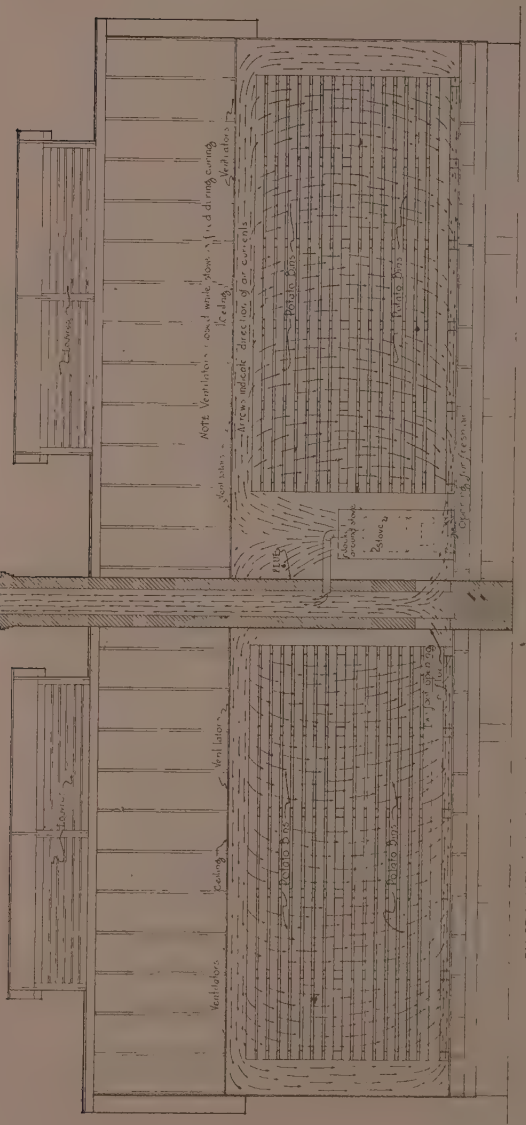


Fig. 33.—Drawing showing plan of ventilation floor doors and flue.


Note Ventilators and wide door used during curing
Arrows indicate direction of air currents
Ventilators
Ventilators
Ventilators
Ventilators
Ventilators
Ventilators
Potato bins
Potato bins
Potato bins

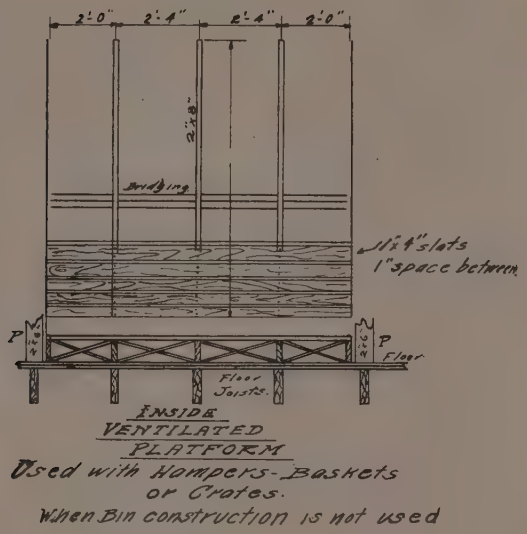


Fig. 35.—Drawing showing inside platform for storage of hampers

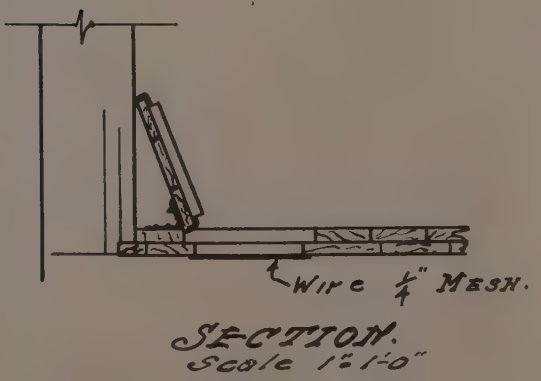
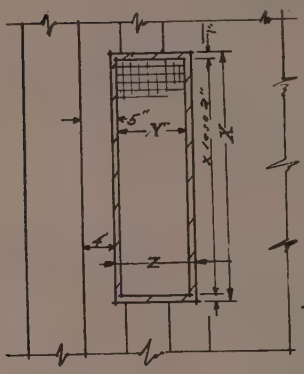


Fig. 36.—Drawing showing section of trap door ventilator.



VENT DOOR SCHEDULE.

	X.	Y	Z.
(A)	5'-0"	10"	12"
(B)	10'-0"	22"	24"
(C)	2'-0"	10"	12"
(D)	4'-0"	22"	24"
(E)	2'-0"	18"	20"

Fig. 37.—Drawing showing floor vent detail and plan of vent door schedule.

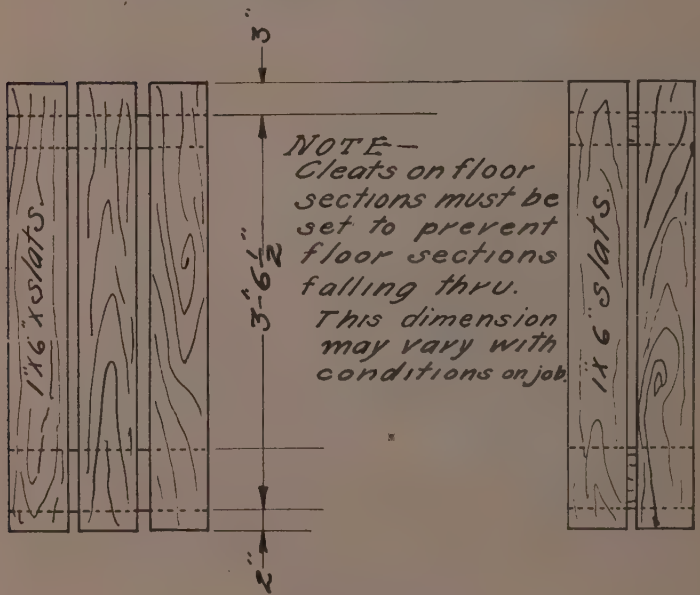


Fig. 38.—Detail floor sections.

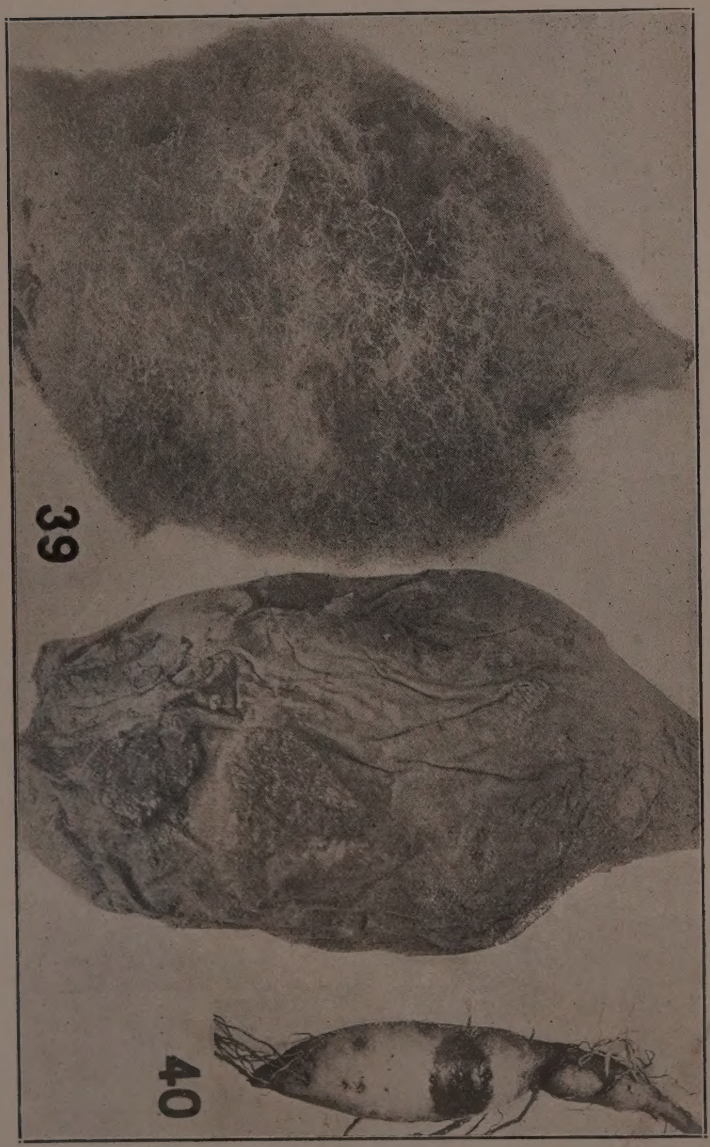


Fig. 39.—Soft rot of sweet potatoes.
Fig. 40.—Black rot.